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Ms. Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 Twelfth Street, S.W.  
Washington, DC 20554

RE: *Carrier Current Systems, Including Broadband over Power Lines Systems*, ET Docket No. 03-104, *Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems*, ET Docket No. 04-37

Dear Ms. Dortch:

Enclosed please find an original and six (6) copies of a letter from Michael D. Gallagher, Acting Assistant Secretary for Communications and Information, U.S. Department of Commerce, to Chairman Michael K. Powell, and accompanying report by the National Telecommunications and Information Administration to be included in the docket of the above-referenced proceeding. A copy of the letter and report were also sent to the Commissioners, and Edmond J. Thomas, Chief of the Office of Engineering and Technology. A copy of the report is also provided on a CD-ROM in pdf format.

Please direct any questions you may have to the undersigned.

Respectfully submitted,

Kathy Smith  
Chief Counsel

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**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Telecommunications and**  
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Washington, D.C. 20230

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**FEDERAL COMMUNICATIONS COMMISSION**  
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The Honorable Michael K. Powell  
Chairman  
Federal Communications Commission  
445 Twelfth Street, S.W.  
Washington, DC 20554

RE: *Carrier Current Systems, Including Broadband over Power Lines Systems*, ET  
Docket No. 03-104, *Amendment of Part 15 regarding new requirements and*  
*measurement guidelines for Access Broadband over Power Line Systems*, ET Docket No.  
04-37

  
Dear Chairman Powell:

Enclosed please find the report prepared by the National Telecommunications and Information Administration (NTIA) entitled *Potential Interference from Broadband over Power Line (BPL) Systems to Federal Government Radio Communications at 1.7 - 80 MHz - Phase I Study*.

Working together over the last three years the Federal Communications Commission (Commission) and NTIA have solved some of the most difficult spectrum challenges facing our country. In 2002 we collaborated to authorize ultrawideband technology and identified 90 MHz of spectrum for advanced wireless services. In 2003, we worked with industry and the Department of Defense to double the spectrum available for WiFi-like services in the 5 GHz band. And, later this year we will begin web-based authorization of very high speed fixed services in the 70, 80, and 90 GHz bands.

Now, President Bush has offered us another opportunity to reinforce U.S. innovation leadership. On March 26<sup>th</sup>, President Bush established the bold goal of universal and affordable broadband access for every American by 2007. Yesterday President Bush provided a roadmap on how we can achieve this vision by, among other things, encouraging the development of new technologies. In this regard, the President called for "technical standards to make possible new broadband technologies, such as the use of high-speed communications directly over powerlines."<sup>1</sup>

Timely and successful completion of the Commission's BPL docket will lay the foundation for meeting the President's vision for the availability of competitive, universal, and

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<sup>1</sup> President George W. Bush, Remarks at the American Association of Community Colleges Annual Convention, Minneapolis Convention Center, Minneapolis, Minnesota (April 26, 2004) (available at <http://www.whitehouse.gov/news/releases/2004/04/20040426-6.html>).

affordable broadband services by 2007. Responsible technical rules that fully address harmful interference concerns with critical systems are a vital component of that foundation. In meeting this objective our agencies must be technically grounded and tenaciously committed to find solutions that both protect critical systems and to allow the realization of the promise of a third broadband wire into the home.

Under your leadership, the Commission began this process with the release of its Notice of Inquiry and Notice of Proposed Rulemaking on this matter.<sup>2</sup> The NTIA Report released today, which identifies interference risks to federal radio systems – and approaches to their resolution – is an important next step. Going forward, NTIA's Phase 2 study will assess the interference risks due to aggregation and ionospheric propagation of interfering signals from BPL systems, refine and apply BPL deployment models, and evaluate the effectiveness of proposed Part 15 measurement techniques.

NTIA will work with the Commission to establish a firm technical foundation for responsible deployment of BPL that will protect critical federal communications systems. There are 59,000 federal frequency assignments in the affected bands of spectrum (1.7 to 80 MHz). These encompass multiple applications, including fixed, mobile, radio astronomy, radar, and broadcasting. The value of the commercial opportunity presented by BPL systems may be very high, but the technical rules governing their deployment must address potential harmful interference to critical systems. The Report which analyzes 10 million measurements of BPL systems provides a roadmap to that end.

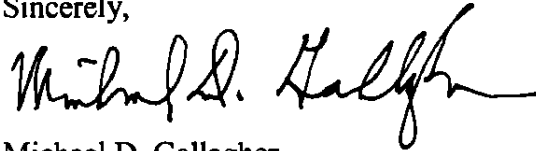
Our strong record of answering difficult spectrum challenges is an excellent foundation for the work that lies ahead. Our agencies need to rely on technical facts and analysis, rigorous application of the scientific method, reasonable assumptions, recognition of the value of potentially affected critical systems, and a strong demand for solutions. Part of NTIA's proposed solution is to protect 41 frequencies for the most sensitive and likely most severely affected federal systems. Protecting these frequencies, which represent less than 6 percent of the frequency capacity of BPL systems, will go a long way toward addressing potentially serious interference concerns. Other reasonable mitigation techniques suggested in the NTIA Report include local registration, intelligent power management, interference absorbing filters, frequency selection, signal injection, and the use of a web-based interface for potentially affected parties.

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<sup>2</sup> *Carrier Current Systems, Including Broadband over Power Lines Systems*, ET Docket No. 03-104, Notice of Inquiry, 68 Fed. Reg. 28182 (May 23, 2003); *Carrier Current Systems, Including Broadband over Power Lines Systems*, ET Docket No. 03-104, *Amendment of Part 15 regarding new requirements and measurement guidelines for Access Broadband over Power Line Systems*, ET Docket No. 04-37, Notice of Proposed Rulemaking, 69 Fed. Reg. 12612 (March 17, 2004).

I look forward to continuing to work with you to achieve the responsible implementation of this exciting new technology as we meet the President's goal of making affordable broadband competitively available to all Americans by 2007.

Sincerely,

A handwritten signature in black ink, appearing to read "Michael D. Gallagher". The signature is fluid and cursive, with a long horizontal stroke at the end.

Michael D. Gallagher  
Acting Assistant Secretary for  
Communications and Information

enclosure

cc: The Honorable Kathleen Q. Abernathy  
The Honorable Jonathan S. Adelstein  
The Honorable Michael J. Copps  
The Honorable Kevin J. Martin  
Edward J. Thomas, Chief, Office of Engineering and Technology

**NTIA Report 04-413**

**POTENTIAL INTERFERENCE FROM BROADBAND OVER  
POWER LINE (BPL) SYSTEMS TO FEDERAL GOVERNMENT  
RADIOCOMMUNICATIONS AT 1.7 - 80 MHz**

**Phase 1 Study**

**VOLUME I**



**U.S. Department of Commerce**  
**Donald Evans, Secretary**

Michael D Gallagher, Acting Assistant Secretary  
For Communications and Information

**APRIL 2004**

**POTENTIAL INTERFERENCE FROM  
BROADBAND OVER POWER LINE (BPL)  
SYSTEMS TO FEDERAL GOVERNMENT  
RADIOCOMMUNICATIONS AT 1.7 - 80 MHz**

**Phase 1 Study**

**VOLUME I**



*technical report*

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U.S. DEPARTMENT OF COMMERCE • National Telecommunications and Information Administration

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## ACKNOWLEDGEMENTS

The measurements and studies underlying this report were performed by NTIA's Spectrum Engineering and Analysis Division (SEAD) and Institute for Telecommunications Science (ITS). The following NTIA personnel contributed substantially to this report and the underlying studies:

Brent Bedford (ITS lead)	ITS	Gary Patrick	SEAD
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Nick DeMinco	ITS	James Richards (admin. lead)	SEAD
Ed Drocella	SEAD	Robert Sole	SEAD
Phil Gawthrop	SEAD	Thomas Sullivan	SEAD
Randall Hoffman	ITS	Clement Townsend	SEAD
Gerald Hurt	SEAD	Cecilia Tucker	SEAD
Bernard Joiner	SEAD	Cou-Way Wang	SEAD
Yeh Lo	ITS	Jonathan Williams	SEAD
Norman Maisel	SEAD	Robert Wilson	SEAD

NTIA is grateful for the cooperation provided by the BPL parties whose systems were subject to measurement. NTIA also greatly appreciates the equipment, special radio network access and radio operator support provided by the Department of Homeland Security for NTIA's testing of BPL interference.

Finally, NTIA would like to thank the Interdepartment Radio Advisory Committee (IRAC) for its review of this report and the inputs it provided.

## **PREFACE**

This Report contains two Volumes. Volume I presents the main text and Volume II contains appendixes that provide additional detail and backup information that is fully summarized in Volume I.



## EXECUTIVE SUMMARY

On April 23, 2003, the Federal Communications Commission (Commission or FCC) adopted a Notice of Inquiry (NOI) seeking information on potential interference from Broadband over Power Line (BPL) systems and associated changes that may be needed to accommodate BPL systems in Part 15 of the Commission's rules.<sup>1</sup> As described in the NOI, "access" BPL systems transmit Internet and other data at radio frequencies over neighborhood power lines and use electrical outlets in BPL users' premises as data ports for computers and other devices. "In-house" BPL systems use indoor wiring for networking within the user's premises.

In its response to the NOI, the National Telecommunications and Information Administration (NTIA) described Federal Government usage of the 1.7-80 MHz frequency range, identified associated interference concerns, and outlined the studies it planned to conduct to address those concerns.<sup>2</sup> NTIA reviewed relevant studies and regulations in order to help refine the scope and priorities for its studies. NTIA parsed its planned studies into two time phases, first addressing technical issues of the most immediate importance. As reported herein, Phase 1 defines interference risks to radio reception in the immediate vicinity of overhead power lines used by "access" BPL systems. It also suggests means for reducing these risks and identifies techniques for mitigating local interference should it occur. Phase 2 of NTIA's studies will evaluate the effectiveness of NTIA's Phase 1 recommendations and address potential interference via ionospheric propagation of BPL emissions from mature large-scale deployments of BPL networks.

NTIA reviewed the comments submitted in response to the NOI in order to characterize existing and potential future BPL systems and deployments. Simple BPL deployment models were addressed in the Phase 1 interference risk analyses. NTIA also developed more sophisticated deployment models for use in future studies.

NTIA summarized technical and operating parameters of over fifty-nine-thousand (59,000) Federal Government frequency assignments in the 1.7-80 MHz frequency range. This information may help operators of BPL systems in development of BPL frequency plans. NTIA then defined representative radio systems for consideration in interference analyses: (1) a land vehicular receiver; (2) a shipborne receiver; (3) a receiver using a rooftop antenna (e.g., a base or fixed-service station); and (4) an aircraft receiver in flight. Federal communications require exceptional protection on frequencies amounting to about 5.4% of the 1.7-80 MHz frequency range. NTIA will address the associated protection requirements in on-going studies.

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<sup>1</sup> *Inquiry Regarding Carrier Current Systems, including Broadband over Power Line Systems*, Notice of Inquiry, ET Docket No. 03-104, April 28, 2003 ("BPL Inquiry").

<sup>2</sup> Comments of the National Telecommunications and Information Administration, BPL Inquiry, August 13, 2003.

NTIA executed three two-week measurement campaigns and used Numerical Electromagnetic Code (NEC) software to characterize BPL signal radiation and propagation. These efforts revealed that BPL systems generate the highest electric field strength near the BPL device for horizontal-parallel polarized signals. However, these systems generate peak vertically-polarized field strength under and adjacent to the power lines and at impedance discontinuities at substantial distances from the BPL device. BPL systems generate peak field strength having horizontal-perpendicular polarization at small distances (e.g., less than 30 meters) from both the BPL device and power lines. Thus, measurements intending to demonstrate compliance with the Part 15 field strength limits should not focus solely on the BPL device.

Using NEC, NTIA evaluated interference risks in terms of the geographic extent of locations where interference may occur to radio reception at four frequencies used by outdoor, overhead BPL systems conforming to existing Part 15 rules. Interference to land vehicle, boat, and fixed stations receiving moderate-to-strong radio signals is likely in areas extending to 30 meters, 55 meters, and 230 meters, respectively, from one BPL device and the power lines to which it is connected. With low-to-moderate desired signal levels, interference is likely at these receivers within areas extending to 75 meters, 100 meters and 460 meters from the power lines. Assuming that co-frequency BPL devices are deployed at a density of one per km<sup>2</sup> within a circular area of 10 km radius, interference to aircraft reception of moderate-to-strong radio signals is likely to occur below 6 km altitude within 12 km of the center of the BPL deployment. Interference likely would occur to aircraft reception of weak-to-moderate radio signals within 40 km of the center of the BPL deployment area. However, at two of the four BPL frequencies considered with the assumed power lines, NTIA predicted smaller areas over which interference is likely.

Critical review of the assumptions underlying these analyses revealed that application of existing Part 15 compliance measurement procedures for BPL systems results in a significant underestimation of peak field strength. Underestimation of the actual peak field strength is the leading contributor to high interference risks. As applied in current practice to BPL systems, Part 15 measurement guidelines do not address unique physical and electromagnetic characteristics of BPL radiated emissions. Refining compliance measurement procedures for BPL systems will not impede implementation of BPL technology because BPL networks reportedly can be successfully implemented under existing field strength limits.<sup>3</sup> Accordingly, NTIA does not recommend that the FCC relax Part 15 field strength limits for BPL systems. Further based on studies to date, NTIA recommends several "access" BPL compliance measurement provisions that derive from existing Part 15 measurement guidelines. Among these are requirements to: use measurement antenna heights near the height of power lines; measure at a uniform distance of ten (10) meters from the BPL device and power lines; and measure using a calibrated rod antenna or a loop antenna in connection with appropriate factors relating magnetic and electric field strength levels at frequencies below 30 MHz.

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<sup>3</sup> Comments of PowerWAN, Inc., BPL Inquiry, July 3, 2003 at 8-9; Comments of Ameripon, Inc., BPL Inquiry, July 7, 2003 at ¶4.8; Reply Comments of PowerComm Systems, Inc., BPL Inquiry, August 20, 2003 at ¶40.

NTIA suggested several means by which BPL interference can be prevented or eliminated should it occur. Mandatory registration of certain parameters of planned and deployed BPL systems would enable radio operators to advise BPL operators of anticipated interference problems and suspected actual interference; thus, registration could substantially facilitate prevention and mitigation of interference. BPL devices should be capable of frequency agility (notching and/or retuning) and power reduction for elimination of interference. NTIA further recommends that BPL developers consider several interference prevention and mitigation measures, including: routine use of the minimum output power needed from each BPL device; avoidance of locally used radio frequencies; differential-mode signal injection oriented to minimize radiation; use of filters and terminations to extinguish BPL signals on power lines where they are not needed; and judicious choice of BPL signal frequencies to decrease radiation.

## TABLE OF CONTENTS

### VOLUME I

ACKNOWLEDGEMENTS .....	iii
PREFACE .....	iv
EXECUTIVE SUMMARY .....	v
TABLE OF CONTENTS .....	viii
GLOSSARY .....	xiii
 SECTION 1      INTRODUCTION	
1.1      Background .....	1-1
1.2      Objectives .....	1-1
1.3      Approach .....	1-2
1.4      Scope .....	1-2
 SECTION 2      TECHNICAL DESCRIPTION OF BPL SYSTEMS	
2.1      Introduction .....	2-1
2.2      BPL System Architectures .....	2-2
2.2.1      BPL System #1 .....	2-2
2.2.2      BPL System #2 .....	2-3
2.2.3      BPL System #3 .....	2-4
2.3      Potential Future Systems .....	2-5
2.4      Summary .....	2-7
 SECTION 3      BPL RELATED STUDIES AND REGULATIONS	
3.1      Introduction .....	3-1
3.2      Regulations .....	3-1
3.2.1      Part 15 of the Commission's Rules .....	3-1
3.2.2      Foreign Regulations .....	3-2
3.3      Studies .....	3-6
3.3.1      Analyses of Interference from BPL Filed Under the FCC NOI ...	3-6
3.3.2      International Telecommunications Union (ITU) Activities .....	3-10
3.3.3      Other Technical Literature .....	3-12
3.4      Conclusion .....	3-12
 SECTION 4      CHARACTERIZATION OF FEDERAL GOVERNMENT RADIO SYSTEMS AND SPECTRUM USAGE	
4.1      Introduction .....	4-1
4.2      Allocations Overview .....	4-2
4.3      Overview of Federal Government Spectrum Use .....	4-4
4.4      Summary of the Representative Federal Government Systems in the 1.7-80 MHz Band .....	4-6
4.5      Representative Technical Characteristics of Federal Equipment .	4-7
4.6      Sensitive or Protected Frequencies in the 1.7-80 MHz Band .....	4-8

4.7	Conclusion .....	4-13
SECTION 5	CHARACTERIZING BPL EMISSIONS THROUGH COMPUTER MODELING AND MEASUREMENTS	
5.1	Introduction .....	5-1
5.2	Theory .....	5-1
5.2.1	Relevant Radiation Theory .....	5-1
5.2.2	Propagation Modes .....	5-2
5.3	BPL Measurements .....	5-3
5.3.1	Approach .....	5-3
5.3.2	Identification and Characterization of BPL Signals .....	5-4
5.3.3	BPL Signal Power Along an Energized Power Line .....	5-4
5.3.4	BPL Signal Power Away from the Energized Power Line .....	5-5
5.3.5	Measurement of BPL Using Various Detectors .....	5-5
5.3.6	Measurement of BPL Using Different Antenna Heights .....	5-6
5.3.7	Measurements of BPL Amplitude Probability Distributions (APDs) .....	5-6
5.4	Analytical Models of Power Line Radiation .....	5-7
5.4.1	Numerical Electromagnetics Code (NEC) .....	5-7
5.4.2	Modeling of Power Lines by NEC .....	5-8
5.4.3	Effects of a Neutral Line .....	5-10
5.4.4	Environmental Noise .....	5-11
5.5	Conclusion .....	5-15
SECTION 6	ANALYSIS OF INTERFERENCE POTENTIAL TO VARIOUS SERVICES	
6.1	Introduction .....	6-1
6.2	Methodology .....	6-1
6.3	Risk Evaluation Criteria .....	6-2
6.3.1	Interfering Signal Thresholds .....	6-2
6.3.2	Noise Calculations .....	6-5
6.4	Interference Models .....	6-5
6.4.1	Receiving Systems .....	6-5
6.4.2	Power Line Model .....	6-7
6.5	Interference Calculations .....	6-7
6.5.1	Scaling Output Power to Meet FCC Part 15 Limits .....	6-7
6.5.2	Analysis Methodology for Land-mobile, Fixed and Maritime Services .....	6-8
6.5.3	Analysis Methodology for Aeronautical Service .....	6-9
6.6	Results of Interference Calculations .....	6-11
6.6.1	Land – Mobile Service .....	6-11
6.6.2	Fixed Service .....	6-15
6.6.3	Maritime Service .....	6-15
6.6.4	Aeronautical Service .....	6-20
6.7	Conclusion .....	6-23

<b>SECTION 7</b>	<b>BPL COMPLIANCE MEASUREMENT PROCEDURES</b>	
7.1	Background .....	7-1
7.2	Measurements Must Address Radiation from Power Lines to Which BPL Devices are Connected .....	7-2
7.3	Measurements Should Address Aggregated Emissions for the Fully Deployed BPL Network .....	7-2
7.4	Measurement Antenna Heights Should Address All Important Directions of BPL Signal Radiation .....	7-3
7.5	A Single Measurement Distance Should Be Used For Overhead Power Lines and BPL Devices .....	7-4
7.6	A Modified Distance Extrapolation Factor is Needed for BPL ...	7-5
7.7	BPL Frequency Agility and Power Line Frequency Selective Effects Must Be Addressed in the Measurement Procedures .....	7-5
7.8	Near Field Measurement Errors Must be Mitigated .....	7-5
7.9	Appropriate Choice of Power Lines Used for BPL Measurements Will Reduce Statistical Sampling Uncertainties ...	7-6
7.10	BPL Device Output Power Should Be Reduced as Needed for Compliance with Radiated Emission Limits .....	7-7
7.11	The Results of Radiated Emission Measurements Should Be Properly Recorded in Measurement Reports and Applied in BPL Operations .....	7-7
7.12	Conclusion .....	7-8
<b>SECTION 8</b>	<b>INTERFERENCE PREVENTION AND MITIGATION TECHNIQUES</b>	
8.1	Introduction .....	8-1
8.2	Power Level .....	8-1
8.3	Avoidance of Locally Used Frequencies .....	8-1
8.4	Differential-mode Signal Injection .....	8-2
8.5	Filters and Signal Terminations .....	8-3
8.6	Implementation of a "one active device per area" rule .....	8-3
8.7	Judicious Signal Carrier Choice .....	8-4
8.8	Maintenance of a Single Point of Control .....	8-4
8.9	Web-based Access to Radio License Information .....	8-4
8.10	BPL Installation and Equipment Registration .....	8-5
8.11	Conclusion .....	8-5
<b>SECTION 9</b>	<b>SUMMARY OF RESULTS</b>	
9.1	Introduction .....	9-1
9.2	Preliminary Investigations .....	9-1
9.2.1	Description of BPL Systems .....	9-1
9.2.2	Studies and Relevant Regulations .....	9-1
9.2.3	Federal Government Radio Systems and Spectrum Usage .....	9-2
9.2.4	Characterization of BPL Emissions .....	9-2
9.3	Phase 1 Analyses .....	9-4
9.3.1	Evaluation of Potential Interference Risks .....	9-4

9.3.2	Risk Reduction Through Compliance Measurement Procedures .	9-6
9.3.3	Techniques for Prevention and Mitigation of Interference .....	9-7
9.4	Topics for Further Study .....	9-9

## VOLUME II

TABLE OF CONTENTS .....		iii
GLOSSARY .....		viii
APPENDIX A RELEVANT PART 15 PROVISIONS		
A.1	Provisions Regarding Field Strength Limits .....	A-1
A.2	Provisions Specifying Compliance Measurements .....	A-2
APPENDIX B SUMMARY OF FOREIGN TECHNICAL REPORTS		
B.1	Introduction .....	B-1
B.2	Implementation Reports .....	B-1
B.3	Measurement Reports .....	B-2
B.4	Modeling and Analysis Reports .....	B-8
APPENDIX C CHARACTERIZATION OF FEDERAL GOVERNMENT SPECTRUM USAGE AND OPERATIONS, REPRESENTATIVE SYSTEMS AND TYPICAL PARAMETERS		
C.1	Introduction .....	C-1
C.2	Services And Example Systems .....	C-1
C.2.1	Fixed Service (1.7-29.7 MHz) .....	C-1
C.2.2	Fixed Service (29.7-80 MHz) .....	C-3
C.2.3	Mobile Service .....	C-4
C.2.4	Land Mobile Service .....	C-7
C.2.5	Maritime Mobile Service .....	C-8
C.2.6	Broadcasting Service .....	C-11
C.2.7	Aeronautical Mobile Service .....	C-12
C.2.8	Standard Frequency and Time Signal .....	C-16
C.2.9	Aeronautical Radionavigation .....	C-17
C.2.10	Radiolocation Service .....	C-18
C.2.11	Amateur and Amateur-Satellite Services .....	C-19
C.3	Federal Government Special Operations .....	C-21
C.3.1	Automatic Link Establishment (ALE) Systems .....	C-21
C.3.2	Sounders .....	C-21
C.3.3	Over the Horizon (OTH) Radars .....	C-22
C.4	Special Operational Considerations .....	C-24
C.4.1	Operational Requirements for Access to Several Frequency Assignments Within an Allocation .....	C-24
C.4.2	Federal Government Use of Radio Frequencies Below 30 MHz for Domestic Fixed Service .....	C-25

C.4.3	Summary of the Emergency Use of Federal Government HF Frequencies for the Shares Program .....	C-26
C.4.4	National Criteria Established Jointly by NTIA and FCC on the Use of Frequencies from Appendix 27 Allotment Plan .....	C-26
APPENDIX D	BROADBAND OVER POWER LINE EMISSION MEASUREMENTS	
D.1	Introduction .....	D-1
D.2	The Measurement System .....	D-1
D.3	BPL Measurements .....	D-3
D.3.1	Background on BPL Emissions Measurements .....	D-3
D.3.2	Measurements of BPL Along the Energized Power Line .....	D-10
D.3.3	Measurements of BPL Away From the Energized Power Line ...	D-23
D.3.4	Measurements of BPL Using Various Detectors .....	D-37
D.3.5	Measurements of BPL Varying Antenna Height .....	D-41
D.3.6	Measurements of BPL APDs .....	D-47
D.4	Background on Amplitude Probability Distributions .....	D-50
D.5	Gain and Noise Figure Calibration Using a Noise Diode .....	D-59
APPENDIX E	BPL MODELING OUTPUT	
E.1	Introduction .....	E-1
E.2	Tables and NEC plots .....	E-1
APPENDIX F	NTIA PHASE 2 STUDY BPL DEPLOYMENT MODELS	
F.1	Introduction .....	F-1
F.2	Neighborhood Deployment Model .....	F-1
F.3	Antenna Coverage Area Deployment Model .....	F-3
F.4	Regional Deployment Model .....	F-4
F.4.1	Regional Deployment Model Description .....	F-5
F.4.2	Density and Distribution of Households .....	F-5
F.4.3	Density and Distribution of BPL Devices .....	F-6
F.4.4	Other Factors .....	F-6
F.4.5	Regional Model Output .....	F-9



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